MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY
MONTANA POLLUTANT DISCHARGE ELIMINATION SYSTEM

Fact Sheet

Permittee:	Apple Rehab West
Permit No.:	MT0023566
Receiving Water:	Prickly Pear Creek
Facility Information:	
Name	Elkhorn Health and Rehabilitation Center, LLC
Location	474 Highway 287 Clancy, MT 59634 Jefferson County 46.449444 N, 111.985278 W
Contact	Sheri Cislo, Administrator Ross Battershell, Operator 474 Highway 287 Clancy, MT 59634
Fee Information:	
Type	Minor Privately Owned Treatment Works
Number of Outfalls	1 (for fee determination purposes)
Type of Outfall	001 – Facility Discharge

I. Permit Status

This fact sheet has been drafted for renewal of Montana Pollutant Discharge Elimination System (MPDES) permit no. MT0023566 for Apple Rehab West, formerly Elkhorn Health and Rehabilitation, LLC for the Elkhorn Health and Rehabilitation Center (EHRC) Wastewater Treatment Plant (WWTP). The existing permit 2009-issued permit was issued September 15, 2009, became effective on November 1, 2009, and expired at midnight, October 31, 2014.

The Montana Department of Environmental Quality (DEQ) received an application from Apple Rehab West for renewal of MT0023566 on July 3, 2014. DEQ replied with a notice of completeness that deemed the application complete and the 2009-issued permit to be administratively continued in a letter dated October 23, 2014.

II. Facility Information

A. Facility Description

The EHRC WWTP serves the residents and employees of a privately-owned rehabilitation facility located in Clancy, MT. EHRC has capacity for 70 residents and approximately 30 staff personnel. All sewage, laundry, maintenance, and kitchen wastewaters are mixed in an equalization tank prior to entering the 1971-installed, 0.015 million gallons per day (gpd) Cantex package WWTP. The WWTP is an extended aeration, activated sludge treatment system followed by a 102,000 gallon polishing/holding pond that was originally constructed in 1971 and upgraded in 2014. A tablet chlorinator was installed in 2014 to provide disinfection of the effluent stream. The 2009-issued permit allows for discharge from the wastewater treatment system after the polishing pond to Prickly Pear Creek via Outfall 001. Effluent flow measuring occurs at the discharge of the chlorination tank, a part of the Cantex package, prior to release to the polishing/holding pond. See **Figure 1**.

A summary of the current facility design criteria is provided in **Table 1**. To achieve required effluent limits several modifications to the EHRC facility have been made, including:

- A sludge wasting tank has been added to facilitate sludge handling and disposal
- Non-contact heating water has been separated from the facility grey water collection system
- Grey water is now routed to the treatment plant equalization tank and combined with black water prior to treatment
- Influent and effluent flow meters have been installed
- A flow control pinch valve was installed in the pump discharge line in a control box outside the equalization tank to control flow into the treatment plant
- A high level alarm was installed in the equalization tank to provide an alarm beacon and horn to alert staff to a high level condition in the tank

Table 1. Current Design Criteria Summary – EHRC WWTP (Cantex Package Plant Operation and Maintenance Manual, 1971)

Facility Description: Continuous discharge, mechanical, extended aeration activated sludge Cantex package plant with chlorination disinfection	
Construction Date: 1971	Modification Date: June 2014
Design Population: ~100	Population Served: ~75
Design Flow, Average (mgd): 0.015	Design Flow, Peak (mgd): Unknown
Minimum Detention Time: 24 hours	
Design BOD Removal (%): Unknown	Design Load (lb/day): 25 (assume 200 mg/L)
Design SS Removal (%): Unknown	Design Load (lb/day): 25 (assume 200 mg/L)
Collection System: Combined [ ] Separate [X]	
SSO Events (Y/N): NA	Number: NA
Bypass Events: None reported	Number: NA
Disinfection: Yes	Type: Chlorination
Discharge Method: Continuous to Prickly Pear Creek via polishing/holding pond	
Effluent Flow Primary Device: Effluent v-notch weir with meter stick	
Effluent Secondary Flow Device: Electronic meter at the discharge from the chlorination chamber	

One portion of the EHRC facility is heated using hot spring groundwater from a source near Warm Springs Creek that briefly enters the building, travels through a piping system and then is cooled and discharged. This water is considered non-contact heating water and is discharged north of the facility in Warm Springs Creek. This water is considered a non-regulated waste stream and is not included in this permit since the geothermal water is returned to the original area of the source and no chemicals are added to this once-through water.

B. Effluent Characteristics

Outfall 001 Effluent Data

Effluent data from the facility Discharge Monitoring Reports (DMRs) for the Period of Record (POR) August 2014 through July 2016 are summarized in **Table 2**. The POR begins in August of 2014, as this date reflects the completion date of the modifications to the EHRC WWTP.

Table 2. DMR Effluent Characteristics for POR August 2014 through July 2016

Parameter	Location	Units	2009 Permit Limit	Minimum Value	Maximum Value	Average Value	Number of Samples[9]
Flow, Daily Average	Effluent	mgd	[1]	0.003	0.077	0.009	24
5-Day Biochemical Oxygen Demand (BOD_5)	Influent	mg/L	[1]	13.7	2,819	373.0	24
	Effluent	mg/L	45/30 [2]	1.0	72	3.6	24
	Effluent	% removal	85	91	100	98	24
	Effluent	lb/day	5.6/3.8[3][2]	0.03	33	0.7	24
Total Suspended Solids (TSS)	Influent	mg/L	[1]	38	6,940	681.3	24
	Effluent	mg/L	45/30 [2]	1.2	158	6.9	24
	Effluent	% removal	85	92	100	97	24
	Effluent	lb/day	5.6/3.8 [3][2]	0.01	81.5	1.5	24
pH	Effluent	s.u.	6.0-9.0	6.1	8.0	7.3	24
Escherichia coli Bacteria [4,7]	Effluent	cfu / 100 mL	252/ 126	0	238	5.9	11
Escherichia coli Bacteria[4,8]	Effluent	cfu / 100 mL	1,260/630	3.5	68,700	340.4	10
Temperature	Effluent	ºC	[5]	7.6	22.5	14.7	24
Total Residual Chlorine	Effluent	mg/L	0.5 [6]	0	0.50	0.38	24
Total Ammonia as N	Effluent	mg/L	[1]	0.04	7.66	0.84	22
Total Kjeldahl Nitrogen	Effluent	mg/L	[1][2]	0.5	9.52	3.8	24
Nitrate + Nitrite as N	Effluent	mg/L	[1]	0.38	14.6	5.4	22
Total Nitrogen [6]	Effluent	mg/L	[1][2]	4.08	16.81	8.27	22
		lb/day	4.6 [3][2]	0.05	6.4	0.53	22
Total Phosphorus as P	Effluent	mg/L	[1][2]	0.35	2.70	1.00	24
		lb/day	0.38 [3]	0.01	1.50	0.07	24
Dissolved Oxygen	Effluent	mg/L	[1]	1.77	6.26	2.82	24
Oil and Grease	Effluent	mg/L	<10 [5]	-	-	-	0
Copper	Effluent	µg/L	[1]	32	32	32	1
Zinc	Effluent	µg/L	[1]	59	59	59	1
Cadmium	Effluent	µg/L	[1]	<0.08	<0.08	<0.08	1

Footnotes:
(1) No effluent limit in previous permit, monitoring requirement only.
(2) Weekly Average Value/Monthly Average Value.
(3) Nondegradation value.
(4) Geometric Average
(5) Instantaneous Maximum Value.
(6) Calculated as the sum of Nitrate + Nitrite as N and Total Kjeldahl Nitrogen (TKN) concentrations.
(7) This limit applies during the period April 1 through October 31.
(8) This limit applies during the period November 1 through March 31.
(9) Number of DMRs analyzed.

C. Compliance History

DEQ performed two compliance inspections at the facility between July 2009 and 2016. The December 28, 2010 Compliance Evaluation Inspection identified several deficiencies:

- pH not analyzed on site as specified by the permit, pH reported using the value obtained by Alpine Laboratory,
- DMR is completed incorrectly with incorrect data in the Number of Exceedance Column,
- System is not being operated as designed,
- Calibration logs for laboratory equipment are missing,
- No Standard Operating Procedures for operation, maintenance and laboratory are in place,
- Failure to record the initials of the person completing the laboratory analysis on the Laboratory Report from Alpine Laboratories,
- No laboratory method recorded for the Dissolved Oxygen analysis,
- Failure to analyze Flow Rate in October 2007, November 2008 and March 2009,
- Failure to analyze Fecal Coliform in November 2007 and January 2008, and
- Failure to analyze Dissolved Oxygen in November 2009, December 2009, January 2010 and February 2010.

The December 23, 2014 Compliance Evaluation Inspection identified no deficiencies and no additional information was requested.

Several numeric limit exceedances were documented for the POR.

- Three numeric limit exceedances for Biochemical Oxygen Demand (BOD_5) for monitoring periods ending September 30, 2014 and March 31, 2015,
- Seven numeric limit exceedances for Total Suspended Solids (TSS) for monitoring periods ending September 30, 2014, March 31, 2015 and June 30, 2015 , and
- Seven numeric limit exceedances for *Escherichia coli* (*E.coli*) for monitoring periods ending November 20, 2014, December 31, 2014, January 31, 2015, February 28, 2015, March 31, 2015, April 30, 2015 and November 30, 2015

The permittee entered into an Administrative Order on Consent (AOC), Docket No. WQ-12-03 with the DEQ on February 9, 2012. The AOC was written to address exceeding permit effluent limits and incomplete DMRs. In a letter dated July 20, 2016, DEQ stated that the permittee had fulfilled the requirements of the AOC and that the enforcement case would be closed.

III. Proposed Technology-based Effluent Limits

A. Scope and Authority

Technology-based Effluent Limits (TBELs) represent the minimum level of control that must be imposed by a permit issued under the MPDES program. DEQ must consider technology available to treat wastewater, and effluent limits that can be consistently achieved by that technology. TBELs are based on currently available treatment technologies and allow the permittee discretion to choose applicable controls to meet those standards.

The Montana Board of Environmental Review (BER) has adopted by reference Title 40 of the Code of Federal Regulations part 133 (40 CFR 133) which defines minimum treatment requirements for secondary treatment for publicly owned treatment works (POTWs) [ARM 17.30.1203(14)(a)]. For non-POTWs, TBELs must be based on EPA promulgated effluent limitation guidelines (ELGs) for dischargers by category or subcategory. EPA has not promulgated ELGs for privately owned WWTPs; therefore, TBELs must be developed on a case-by-case basis, based on the best professional judgement (BPJ) of the permit writer. Secondary treatment is defined in terms of effluent quality as measured by BOD_5, TSS, percent removal of BOD_5 and TSS, and pH. It is reasonable to impose secondary treatment standards for this facility based on BPJ. Applying the secondary treatment standards with BPJ, TBELs satisfy the requirement of ARM 17.30.1203(6).

National secondary standards (NSS) specify the minimum of effluent quality in terms of the parameters BOD_5 and TSS. For BOD_5 and TSS the 30-day average shall not exceed 30 mg/L and the 7-day average shall not exceed 45 mg/L. The 30-day average percent removal for BOD_5 and TSS shall not be less than 85 percent. The effluent limits for pH must be maintained within the range of 6.0 to 9.0.

B. Mass-Based Limits

Effluent limits must be expressed in terms of mass (mass/time), except for certain conditions, such as pH or temperature. For POTWs, mass-based limits are based on average daily design flow for the facility. Although the EHRC WWTP is not a POTW it is appropriate to approach the mass-based limits in the same manner. The EHRC WWTP has an average daily design flow on 0.015 mgd.

The mass-based limits for the EHRC WWTP are calculated as follows:

Load (lb/day) = Design Flow (mgd) x Concentration Limit (mg/L) x 8.34 (lb·L)/(mg·gal)

BOD_5:

7-day	Load = 0.015 mgd x 45 mg/L x 8.34	=	5.6 lbs/day
30-day	Load = 0.015 mgd x 30 mg/L x 8.34	=	3.8 lbs/day

TSS:

7-day	Load = 0.015 mgd x 45 mg/L x 8.34	=	5.6 lbs/day
30-day	Load = 0.015 mgd x 30 mg/L x 8.34	=	3.8 lbs/day

C. Nondegradation Load Allocations

The provisions of ARM 17.30.701 - 718 (Nondegradation of Water Quality) apply to new or increased sources of pollution [ARM 17.30.702(18)]. Sources that are in compliance with the conditions of their permit and do not exceed the limits established in the permit or determined from a permit previously issued by DEQ are not considered new or increased sources.

Nondegradation threshold values for the EHRC WWTP are calculated for BOD_5 and TSS with a design flow of 0.015 mgd. The nondegradation load allocations and the actual average loads discharged from the facility for the POR are presented below in **Table 3**. These data indicate that the facility did not exceed the nondegradation load values calculated for BOD_5 and TSS.

Notice in **Table 3**, the 2014 data is for the months of October through December, this because data collected prior to October 2014 were at least an order of magnitude greater than any other data and therefore treated as an outlier and left out of calculations.

Table 3. Nondegradation and Actual Loads for POR

Parameter	Units	Nondegradation Allocated Load*	Actual 30-Day Annual Average Load**		
		30-Day Annual Average Load	2014(1)	2015	2016(2)
BOD_5	lb/day	3.8	0.20	0.02	0.04
TSS	lb/day	3.8	0.19	0.30	0.07

Footnotes:
(1) 2014 data was collected October – December.
(2) 2016 data was collected January – July.
*Original allocated loads from SOB dated July 29, 2009.
**Actual loads are based on annual averages of the monthly values reported on DMRs.

Load limits for technology-based parameters of concern (BOD_5 and TSS) will apply to the effluent and will be maintained at the more stringent of the nondegradation allocations or mass-based loading limits calculated in this Fact Sheet.

D. Proposed TBELS

Table 4: EHRC WWTP Proposed TBEL and Mass-Based Load Limits(1)

Parameter	Units	Average Monthly Limit	Average Weekly Limit	Rationale
BOD_5	mg/L	30	45	40 CFR 133.102(a)
	lb/day	3.8	5.6	
	% removal	85(2)	NA	
TSS	mg/L	30	45	40 CFR 133.102(b)
	lb/day	3.8	5.6	
	% removal	85(2)	NA	
pH	s.u.	6.0 - 9.0 (instantaneous)		40 CFR 133.102(c)

Footnotes:
(1) See Definitions section at end of permit for explanation of terms.
(2) The arithmetic mean of the values for effluent samples collected in a period of 30 consecutive days shall not exceed 15% of the arithmetic mean of the values for influent samples collected at approximately the same time during the same period (85% removal).

IV. Water Quality-based Effluent Limits

A. Scope and Authority

Permits are required to include Water Quality-based Effluent Limits (WQBELs) when TBELs are not adequate to protect state water quality standards. Montana water quality standards require that no wastes may be discharged that can reasonably be expected to violate any state water quality standards. Montana water quality standards also define both water use classifications for all state waters and numeric and narrative standards that protect those designated uses.

B. Receiving Water

The EHRC WWTP discharges to Prickly Pear Creek approximately 650 feet upstream of the confluence with Warm Springs Creek. The segment of Prickly Pear Creek the facility discharges to is located in the Upper Missouri River watershed as identified by U.S. Geological Survey (USGS) Hydrologic Unit Code (HUC) 10030101 and Montana assessment unit MT41I006_050, Prickly Pear Creek, Spring Creek to Lump Gulch.

Prickly Pear Creek is classified as B-1 according to Montana Water Use Classifications [ARM 17.30.610(2(a)]. Waters classified as B-1 are to be maintained suitable for drinking, culinary, and food processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply [ARM 17.30.623(1)].

The assessment unit to which the facility discharges is listed as impaired in DEQ's Draft 2016 and the Final 2014 303 (d) lists (Clean Water Act Information Center, CWAIC). This segment is not fully supporting aquatic life and drinking water. The probable causes of impairment are: alteration in stream-side or littoral vegetative covers, cadmium, lead, zinc, physical substrate habitat alterations, and sedimentation-siltation. The probable sources of these impairments are impacts from abandoned mine lands (inactive), acid mine drainage, mine tailings, placer mining, and streambank modifications/destabilization.

The Lake Helena TMDLs have been completed for cadmium, lead, zinc and sedimentation-siltation; which are the parameters that are the sources of impairments in assessment unit MT41I006_050 of Prickly Pear Creek.

Except for nutrients, the critical upstream flow value is the 7-day average expected to occur every 10 years (7Q10) of 7.75 cubic feet per second (cfs), which is equivalent to 5.01 mgd. This value was determined using the most current data published by the U.S. Geological Survey (USGS). The USGS maintains flow measuring capabilities on Prickly Pear Creek at gauging station number 06061500 near Clancy, MT (USGS 2015). This results in a dilution ratio of 334:1 (5.01 mgd receiving water flow/0.015 mgd WWTP design flow).

DEQ uses the seasonal 14-day average expected to occur every five years (14Q5) for parameters such as Total Nitrogen (TN) and Total Phosphorus (TP). The seasonal 14Q5 for this gauging station is 11.8 cfs, which is equivalent to 7.63 mgd (July-October) (USGS 2015).

Fish species commonly present year-round include the mottled sculpin, brook trout, longnose sucker, and white sucker. Abundant year-round resident species are the Brown trout, and rainbow trout. Rare species present as year-round residents are westslope cutthroat trout according to Montana Fisheries Information System (MFISH website, September 2016). Early life stages of each of these species can be present year-round (*Spawning Times of Montana Fishes* D.Skaar, MFWP, March 2001).

Ambient Water Quality Data

Table 5 provides a summary of the ambient water quality data used in assessing Reasonable Potential (RP) to exceed the water quality standards in the Prickly Pear Creek, and to develop any necessary effluent limits designed to protect these standards. Ambient water quality data was measured at Montana Volunteer Water Quality's monitoring site location MTVOLWQM_WQX-UPPC11, located approximately 750 feet downstream from the convergence of Prickly Pear Creek and Weimer Creek. The Total Residual Chlorine (TRC) concentration in the stream is assumed to be 0 µg/L because there is no significant source upstream from EHRC that would pollute Prickly Pear Creek with chlorine.

Table 5. Prickly Pear Creek- Ambient Water Quality Monitoring Data

Parameter	Units	75th Percentile	Number of Samples	Monitoring Data Source
Hardness	mg/L	29(1)	7	MTVOLWQM_WQX-UPPC11
pH	s.u.	8.18	7	MTVOLWQM_WQX-UPPC11
Temperature	°C	9.25	7	MTVOLWQM_WQX-UPPC11
Copper, Total Recoverable	µg/L	1.5	4	MTVOLWQM_WQX-UPPC11
Lead, Total Recoverable	µg/L	0.5	6	MTVOLWQM_WQX-UPPC11
Zinc, Total Recoverable	µg/L	2.5	5	MTVOLWQM_WQX-UPPC11
Total Ammonia as N	mg/L	0.05	3	MTVOLWQM_WQX-UPPC11
$NO_3 + NO_2$	mg/L	0.025	7	MTVOLWQM_WQX-UPPC11
Total Nitrogen as N (summer)	mg/L	0.1(3)	4	MTVOLWQM_WQX-UPPC11
Total Phosphorus as P (summer)	mg/L	0.015(4)	7	MTVOLWQM_WQX-UPPC11
Dissolved Oxygen	mg/L	11.71	7	MTVOLWQM_WQX-UPPC11

Footnotes: ND = nondetect
(1) Hardness is the 25th percentile value.
(2) The 75th percentile of TN results for four samples during the months of April-October, and for two samples during the summer months of July-October were both 0.1 mg/L.
(3) The 75th percentile of TP results for seven samples April-December was 0.015 mg/L; the results for three samples during summer months of July-October was 0.143mg/L.

C. Applicable Water Quality Standards

Discharges to surface water classified B-1 are subject to the specific water quality standards of Administrative Rules of Montana (ARM) 17.30.623, Department Circulars DEQ-7 (Numeric Water Quality Standards) and 12A (Base Numeric Standards), and the general provisions of ARM 17.30.635 through 637. In addition to these standards, discharges are subject to ARM 17.30 Subchapter 5 (Mixing Zones) and Subchapter 7 (Nondegradation).

D. Mixing Zone

A mixing zone is an area where the effluent mixes with the receiving water and certain water quality standards may be exceeded. Mixing zones must have the smallest practicable size, a minimum practicable effect on water uses, and definable boundaries. DEQ will determine the appropriateness of a mixing zone and will grant a mixing zone, deny the mixing zone, or grant an alternative or modified mixing zone. Requirements governing the granting of mixing zones are found in Montana Code Annotated (MCA) 75-5-301 and in ARM 17.30.501.

A standard mixing zone may be granted for facilities that discharge a mean annual flow of less than 1 mgd to a stream segment with a dilution ration greater than or equal to 100:1[ARM 17.30.516(3)(a)]. The amount of the 7Q10 allowed for dilution as part of the standard mixing zone is dependent on the size of the discharge relative to the receiving water flow. Because the dilution ratio is 337:1 and discharge flow is less than 1 mgd, the discharge would qualify for a standard mixing zone using the full 7Q10 flow for applicable calculations.

The DEQ-defined mixing zone in the 2009-issued permit ended nearly one mile downstream from the discharge location, at a point just beyond the confluence with Clancy Creek. This was based on the fact that both Warm Springs and Clancy Creeks contribute "considerable flow" to Prickly Pear Creek. Because the dilution ratio is 334:1 and flow is less than 1 mgd, the discharge qualifies for a standard mixing zone using the full 7Q10 flow for applicable calculations. However, the length of a standard mixing zone must not extend downstream more than the most restrictive of one-half mixing width distance (A½) or 10 times the stream width at 7Q10 flow.

In order to be the smallest practicable size and lacking the physical data to determine A½, DEQ will set the mixing zone at 10 times the stream width at 7Q10 flow. The stream width was measured near the point of discharge by DEQ personnel on August 9, 2007; flow was estimated to be near 7Q10 (7.8 cfs) and stream width was measured at 15.5 feet. Therefore the chronic mixing zone distance was reduced to a point 155 feet downstream of the outfall location for total ammonia as nitrogen and total residual chlorine. Acute mixing zone will be 10% of that the length of the chronic mixing zone, or 15.5 feet downstream from the outfall location.

For the purposes of developing effluent limitations for ammonia and total residual chlorine on behalf of EHRC, DEQ will grant initial dilution for the chronic condition using 100 percent of the 7Q10 low flow, 7.75 cfs and the acute condition using 10 percent of the 7Q10 low flow, 0.775 cfs. These dilution amounts will be granted because of the large dilution ratio between Prickly Pear Creek and the EHRC effluent and the first order decay rate ammonia and total residual chlorine undergo. Also, Warm Springs Creek joins Prickly Pear Creek roughly 650 feet downstream from the EHRC outfall contributing considerable flow to Prickly Pear Creek which provides increased dilution for all water quality parameters.

DEQ will also grant the full seasonal 14Q5 dilution flow of 11.8 cfs to evaluate RP and develop nutrient limits.

E. Basis for Proposed Water Quality-based Effluent Limits

Permits are required to include WQBELs when TBELs are not adequate to protect water quality standards, and no waste may be discharged that can reasonably be expected to violate any standard. Pollutants typically present in effluent from facilities treating domestic sewage include conventional pollutants such as BOD_5, TSS, pH, oil and grease, and *E .coli* bacteria; and non-conventional pollutants such as low dissolved oxygen (DO), total residual chlorine (TRC), nitrate/nitrite, nutrients, total ammonia, and toxic pollutants such as volatile organics and metals.

The need for WQBELs is determined based on RP analysis for certain pollutants to determine if numeric or narrative water quality standards may be exceeded. RP calculations utilize the receiving water concentration; the maximum projected effluent concentration, the design flow of the wastewater treatment facility, and the applicable receiving water flow.

DEQ uses a mass balance equation to determine RP (Equation 1). Equation 1 is used to determine the concentration of a pollutant of concern after accounting for other sources of pollution in the receiving water and any dilution by a mixing zone.

$$C_r = \frac{C_d Q_d + C_s Q_s}{Q_s + Q_d} \quad \text{(Equation 1)}$$

Where:

Q_s = receiving water, low flow rate before discharge available for dilution (mgd)
C_s = upstream receiving water pollutant concentration (mg/L), 75th percentile
Q_d = effluent flow rate (mgd), average daily design flow
C_d = critical effluent pollutant concentration (mg/L)
Q_r = receiving water flow rate after discharge ($Q_r = Q_s + Q_d$; mgd)
C_r = receiving water pollutant concentration (after dilution; mg/L)

If C_r > standard, then RP exists and a WQBEL must be developed.

The critical effluent concentration is obtained following the method recommended by the EPA *Technical Support Document for Water Quality-based Toxics Control* (TSD, 1991). The critical effluent concentration (C_d) for each parameter equals the maximum effluent concentration reported by the facility multiplied by the TSD multiplier (based on the data set, coefficient of variation, and sample size at the 95% confidence interval).

When no mixing or dilution in the receiving water is available and the critical effluent concentration exceeds the water quality standard, RP exists and limits are developed based on achieving the water quality standard at the point of discharge.

DEQ is proposing effluent limits for pollutants with RP for which adequate data exist, as discussed in the following section. A complete RP analysis is included in **Attachment A**.

1. Conventional Pollutants

TSS, BOD_5 and pH: These parameters are typical effluent quality indicators for domestic wastewater treatment facilities and are regulated as TBELs. The facility provides a significant reduction in biological material, solids and pH through secondary treatment (Section III) meeting national secondary standards and no additional WQBELs will be required for these parameters.

Oil and Grease (O&G): The 2009-issued permit included an O & G instantaneous maximum limit of <10 mg/L and required quarterly monitoring. Montana regulations require state waters be free from substances attributable to municipal discharges that will result in concentrations of oil and grease in excess of 10 mg/L. The limit and monitoring will be retained in the proposed permit.

***Escherichia coli (E. coli)* Bacteria:** Pathogens are known municipal wastewater contaminants. The state has promulgated *E. coli* standards to protect the beneficial uses of receiving waters from pathogens. The standards for B-1 classified waters are:

a. April 1 through October 31 of each year- the geometric mean number of the microbial species *E. coli* bacteria must not exceed 126 colony forming units (cfu) per 100 milliliters (mL), nor are 10% of the total samples during any 30-day period to exceed 252 cfu per 100 mL; and

b. November 1 through March 31 of each year the geometric mean number of *E. coli* bacteria shall not exceed 630 cfu per 100 mL and 10% of the samples during any 30-day period may not exceed 1,260 cfu per 100 mL.

During the time of the *E. coli* exceedances discussed in Section II of this Fact Sheet, several factors contributed to the violations. The spring and fall months provide continual difficulties with the rapid changes in weather which have the potential of causing flow surges. Facility renovations and fine tuning the operation of the facility have considerably reduced the occurrence of exceedances for all conventional parameters.

These criteria will be included in the proposed permit as average monthly and average weekly limits along with regular monitoring.

2. Nonconventional Pollutants

Total Ammonia as N: Determination of RP for the total ammonia as N (ammonia) and development of applicable limits are based on water quality standards that account for a combination of pH and temperature of the receiving stream during critical conditions, the presence or absence of salmonid species, and the presence or absence of fish in early life stages. The instream critical condition for both pH and temperature is the 75^{th} percentile of the data. Salmonid fishes and their early life stages are presumed present year-round in Prickly Pear Creek based on "Spawning Times of Montana Fishes" (MFISH).

Table 6 presents the total ammonia as N water quality standards for Prickly Pear Creek using the ambient water quality data in **Table 5**.

Table 6. Total Ammonia as N Water Quality Standards for Prickly Pear Creek

Condition	Period	Salmonids Present	Early Life Stages Present	Ambient Condition		Water Quality Standard (1) (mg/L)
				pH	Temperature °C	
Acute	Annual	Yes	NA	8.2	NA	3.83
Chronic	Annual	NA	Yes	8.2	9.25	1.79

Footnotes: NA – Not Applicable
(1) Acute – maximum daily; Chronic - 30-day average concentration, based on Department Circular DEQ-7 (October 2012)

No RP was determined for the chronic condition.

RP to exceed the acute water quality standard for total ammonia was assessed using Equation 1, where:

C_r = receiving water concentration (RWC) after mixing, mg/L
C_d = maximum projected effluent concentration, 14.89 mg/L
C_s = RWC upstream of discharge, 0.05 mg/L
Q_s = applicable receiving water flow, 10% of the 7Q10, 5.01 mgd
Q_d = facility design flow rate, 0.015 mgd

The projected maximum concentration for total ammonia (C_d) was found following the TSD Method. A multiplier of 1.94 was determined using the TSD methodology, given a CV of 2.15, a sample size of 22. The maximum reported effluent for total ammonia was 7.66 mg/L. The multiplier times the maximum concentration is 14.89 mg/L (1.94 * 7.66 mg/L).

$$C_r = \frac{(0.015 * 14.89) + (0.501 * 0.05)}{(0.015 + 0.501)} = 0.48 \text{ mg/L}$$

C_r (0.48 mg/L) is less than acute ammonia standards for Prickly Pear Creek, therefore, RP does not exist for this parameter and no limit is necessary.

Nitrate plus Nitrite (N+N): Nitrate and nitrite are toxic components of total nitrogen, which is a common constituent of domestic wastewater. The human health standard for N+N is 10 mg/L.

RP to exceed the acute water quality standard for N+N was assessed using Equation 1, where:

C_r = receiving water concentration (RWC) after mixing, mg/L
C_d = maximum projected effluent concentration, 18.36 mg/L
C_s = RWC upstream of discharge, 0.025 mg/L
Q_s = applicable receiving water flow, 25% of the 7Q10, 5.01 mgd
Q_d = facility design flow rate, 0.015 mgd

The projected maximum concentration for total (N+N) (C_d) was found following the TSD Method. A multiplier of 1.26 was determined using the TSD methodology, given a CV of 0.54, a sample size of 24. The maximum reported effluent for total (N+N) was 7.66 mg/L. The multiplier times the maximum concentration is 18.36 mg/L (1.26 * 14.6 mg/L).

$$C_r = \frac{(0.015 * 18.36) + (.501 * 0.025)}{(0.015 + 0.501)} = 0.58 \text{ mg/L}$$

C_r (0.58 mg/L) is less than the N+N Human Health Standard, therefore, RP does not exist for this parameter and no limit is necessary.

Total Residual Chlorine (TRC): TRC has an acute aquatic life standard of 0.019 mg/L and a chronic aquatic life standard of 0.011 mg/L. Improvements to the EHRC WWTP were made in 2014 which included the installation of a chlorinator for effluent disinfection.

No RP was determined for the chronic condition.

RP to exceed the acute water quality standard for TRC was assessed using Equation 1, where:

C_r = receiving water concentration (RWC) after mixing, mg/L
C_d = maximum projected effluent concentration, 0.5 mg/L
C_s = RWC upstream of discharge, 0.0mg/L
Q_s = applicable receiving water flow, 10% of the 7Q10, 5.01 mgd
Q_d = facility design flow rate, 0.015 mgd

The projected maximum concentration for TRC (C_d) was found following the TSD Method. A multiplier of 1.28 was determined using the TSD methodology, given a CV of 0.58, a sample size of 24. The maximum reported effluent for TRC was 0.5 mg/L. The multiplier times the maximum concentration is 0.64 mg/L (1.28 * 0.5 mg/L).

$$C_r = \frac{(0.015 * 0.64) + (0.501 * 0.0)}{(0.015 + 0.501)} = 0.019 \text{ mg/L}$$

C_r (0.019 mg/L) does not exceed the acute TRC standard for Prickly Pear Creek, therefore, RP does not exist for this parameter. An instantaneous maximum of 0.5 mg/L will remain for this permit cycle.

Nutrients (TN and TP): Since the 2009-issued permit, EHRC implemented necessary treatment to attain limits (Lake Helena TMDL 2006). The Lake Helena TMDL Volume II – Final Report states that based on analyses that were presented in the Lake Helena watershed Volume 1 report, nutrient problems do not exist in the Montana assessment unit MT41I006_050, Prickly Pear Creek, Spring Creek to Lump Gulch.

In July 2014, Montana adopted base numeric nutrient standards. For wadeable streams in the Middle Rockies ecoregion, where Prickly Pear Creek is located, the numeric nutrient standards for TP and TN are 0.03 mg/L and 0.3 mg/L, respectively (which apply from July 1 to September 31).

The seasonal receiving water concentration for total nitrogen was calculated using *Equation 1*, where:

C_r = receiving water concentration (RWC) after mixing, mg/L
C_d = maximum projected effluent concentration, 22.2 mg/L
C_s = RWC upstream of discharge, 0.01 mg/L
Q_s = applicable receiving water flow, 100% of the 14Q5, 7.63 mgd
Q_d = facility design flow rate, 0.015 mgd

The projected maximum concentration for total nitrogen was found following the TSD method. A multiplier of 1.898 was determined using the TSD methodology, given a CV of 0.6 and a sample size of 8 at the 95% confidence interval. The maximum reported effluent for total nitrogen was 11.7 mg/L. The multiplier times the maximum concentration is 22.2 mg/L (1.898* 11.7 mg/L).

$$C_R = \frac{(0.015 * 22.2) + (7.63 * 0.1)}{(0.015 + 7.63)} = 0.143 \text{ mg/L}$$

TN receiving water concentrations after mixing do not exceed the numeric nutrient standard of 0.3 mg/L; therefore, there will be no need for a TN limit with this permit renewal.

The receiving water concentration for total phosphorus was calculated using *Equation 1*, where:

C_r = receiving water concentration (RWC) after mixing, mg/L
C_d = maximum projected effluent concentration, 5.13 mg/L
C_s = RWC upstream of discharge, 0.015 mg/L
Q_s = applicable receiving water flow, 100% of the 14Q5, 7.63 mgd
Q_d = facility design flow rate, 0.015 mgd

The projected maximum concentration for total phosphorus was found following the TSD method. A multiplier of 1.898 was determined using the TSD methodology, given a CV of 0. 6 and a sample size of 8 at the 95% confidence interval. The maximum reported effluent for total phosphorus was 2.7 mg/L. The multiplier times the maximum concentration is 5.13 mg/L (1.898 * 2.7 mg/L).

$$C_R = \frac{(0.015 * 5.13) + (7.63 * 0.015)}{(0.015 + 7.63)} = 0.025 \text{ mg/L}$$

TP receiving water concentrations after mixing do not exceed the numeric nutrient standard of 0.03 mg/L; therefore, there will be no need for a TP limit with this permit renewal.

Dissolved Oxygen (DO): Low DO levels can be a typical pollutant of concern for extended aeration package plants. Freshwater aquatic life standards are characterized by the fishery (cold- or warm-water) and by the presence or absence of fish in early life stages (Circular DEQ-7); they are presented in **Table 8**, below. Standards are further defined based on a specific period of time and required instream DO levels. The WWTP is an aerated activated sludge package plant with short retention times. DO was monitored at this facility in previous permit cycles.

Table 8. DO Standards For Waters Classified as "B-1" (Circular DEQ-7, 2012).		
Dissolved Oxygen (mg/L)	For Waters Classified A-1, B-1, B-2, C-1, and C-2	
	Early Life Stages [1, 2]	Other Life Stages
30 Day Mean	N/A(3)	6.5
7 Day Mean	9.5(6.5)	N/A(3)
7 Day Mean Minimum	N/A(3)	5.0
1 Day Minimum(4)	8.0 (5.0)	4.0

Footnotes:
(1) These are water column concentrations recommended to achieve the required inter-gravel DO concentrations shown in parentheses. For species that have early life stages exposed directly to the water column, the figures in parentheses apply.
(2) Includes all embryonic and larval stages and all juvenile forms of fish to 30-days following hatching.
(3) N/A (Not Applicable)
(4) All minima should be considered as instantaneous concentrations to be achieved at all times.

DEQ has determined that the TBEL for BOD_5 is sufficient to protect the receiving water for DO. The receiving water DO concentration of 11.71 mg/L (75^{th} percentile) is above the water quality standards for B-1 classified waters; therefore, no limit for DO is proposed.

3. Toxic Pollutants

Concentrations of carcinogenic, bio-concentrating, toxic, or harmful parameters which would remain in the water after conventional treatment may not exceed the applicable standards specified in Circular DEQ-7 [ARM 17.30.623(2)(j)].

Metals - All metals discussion refers to the metals in their "total recoverable" fraction with the exception of aluminum which is regulated and monitored in the dissolved form. Prickly Pear Creek is listed as impaired for copper, lead, and zinc in the 2014 and 2016 draft 303 (d) lists.

Surface water aquatic life and human health standards for copper, lead, and zinc are summarized in **Table 9** for Prickly Pear Creek. The applicable hardness-based standards are calculated using the 25^{th} percentile value for the upstream total hardness data set (29 mg/L as $CaCO_3$). The 25^{th} percentile, low hardness condition is used to be protective of the receiving water year-round.

Table 9. Prickly Pear Creek Metals Surface Water Criteria (Circular DEQ-7)					
Parameter	Unit	Required Reporting Value (RRV)	Human Health Standard	Aquatic Life Standards (1)	
				Acute	Chronic
Copper, Total Recoverable	µg/L	2	1,300	4.36	3.24
Lead, Total Recoverable	µg/L	0.3	15	16.89	0.66
Zinc, Total Recoverable	µg/L	8	2,000	41.98	41.98

Footnotes:
(1) Applicable metals standards calculated using the 25^{th} percentile upstream total hardness value of 29 mg/L as $CaCO_3$

Data have been collected regarding metals in the treated effluent at EHRC. There was one sample for each metal during the POR and this did not create a large enough data set to accurately assess RP for copper, lead, and zinc. The metal samples were collected after the chlorination tank rather than after the polishing pond, which is the location specified in the permit for collection of all effluent samples. Sampling after the chlorination tank does not give EHRC credit for any treatment within the polishing pond which could potentially lower metal concentrations in the effluent stream. Effluent monitoring will be increased to quarterly monitoring during this permit cycle, which will provide a larger data set to analyze whether chronic dilution will be granted for metals in the next permit cycle.

Table 12 provides the effluent monitoring frequency requirements for this permit cycle.

Organic Substances: As a nursing care facility there is limited potential for organic compounds to be present in wastewaters treated by the package plant. Concentrations of total cyanide and total phenols were measure at <0.05 mg/L and <0.011 mg/L respectively which are below the minimum detection level (ML) for both parameters. No monitoring or limitations will be required with this permit cycle.

Whole Effluent Toxicity (WET) Testing: State regulation requires that state water be free from substances attributable to municipal waste that create condition which are harmful or toxic to human, animal, plant or aquatic life, except DEQ allows limited toxicity in a mixing zone provided that there is no acute lethality to organisms. The EHRC is not technically municipal waste, however, the character of the discharge consists of domestic wastewater which is similar to municipal waste.

The EHRC WWTP is a small discharge with significant dilution and no identified industrial contributions. No WET testing will be required with this permit cycle.

V. Effluent Limitations

The proposed final effluent limitations are a combination of the more stringent of the TBELs and WQBELs as developed in Sections III and IV.

Outfall 001

Final Limitations

Table 11 presents the proposed final effluent limits for Outfall 001. Effective through the term of the permit, EHRC will be required to meet the following effluent limits:

Table 11. Outfall 001 Final Limitations

Parameter	Units	Effluent Limitations		
		Average Monthly Limit (1)	Average Weekly Limit (1)	Maximum Daily Limit (1)
5-Day Biochemical Oxygen Demand (BOD_5)	mg/L	30	45	--
	lb/day	3.8	5.6	--
	% Removal	85	N/A	--
Total Suspended Solids	mg/L	30	45	--
	lb/day	3.8	5.6	--
	% Removal	85	N/A	--
E. coli Bacteria - summer (2)	cfu/100 mL	126	252	--
E. coli Bacteria - winter(3)	cfu/100 mL	630	1,260	--
Oil and Grease	mg/L	--	--	10
Total Residual Chlorine	mg/L	--	--	0.50 (4)
pH	s.u.	6.0 - 9.0 (instantaneous)		

Footnotes: N/A = Not Applicable
(1) See Definition section at end of permit for explanation of terms.
(2) This limit applies during the period April 1 through October 31.
(3) This limit applies during the period November 1 through March 31.
(4) Instantaneous maximum value.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

There shall be no discharge which causes visible oil sheen in the receiving stream.

VI. Self-Monitoring Requirements

A. Effluent Monitoring

Beginning with the effective date of the permit and lasting through the term of the permit, the permittee shall monitor for compliance and sample at the effluent weir from the polishing/holding pond prior to mixing with the receiving waters.

Monitoring frequencies are increased to assess compliance with maximum daily, seven-day, and 30-day effluent limits. Self-monitoring requirements are summarized in **Table 12**.
Samples shall be collected, preserved and analyzed in accordance with approved procedures listed in 40 CFR 136. In order to be representative of the nature and volume of the flow being monitored, influent sample collection and flow monitoring must occur prior to the equalization basin or any recycle flow returns.

The ML is DEQ's best determination of a level of analysis that can be achieved by the majority of the commercial, university, or governmental laboratories using EPA-approved methods or methods approved by DEQ.

The EPA-approved analytical methods in 40 CFR Part 136 require TRC samples to be analyzed immediately. On-site analysis of TRC using an approved method is required. The method must achieve a minimum detection level of 0.10 mg/L.

If no discharge occurs during the entire monitoring period, it shall be stated on the Discharge Monitoring Report that no discharge or overflow occurred.

Table 12. Outfall 001 Self-Monitoring Requirements

Parameter	Unit	Sample Location	Minimum Sample Frequency	Sample Type [1]	Reporting Requirement	ML[7]
Flow	mgd	Influent	Continuous	Instantaneous	Daily Maximum Monthly Flow	0.001
	mgd	Effluent	Continuous	Instantaneous	Daily Maximum Monthly Flow	0.001
5-Day Biochemical Oxygen Demand (BOD_5)	mg/L	Influent	1/Month	Composite	Weekly Average Monthly Average	10
	mg/L	Effluent	1/Week	Composite		2
	lb/day	Effluent	1/Month	Calculated		0.1
	% Removal [2]	Effluent	1/Month	Calculated	Monthly Average	0.1
Total Suspended Solids (TSS)	mg/L	Influent	1/Month	Composite	Weekly Average Monthly Average	10
	mg/L	Effluent	1/Week	Composite		10
	lb/day	Effluent	1/Month	Calculated		1
	% Removal [2]	Effluent	1/Month	Calculated	Monthly Average	0.1
pH	s.u.	Effluent	1/Week	Instantaneous	Daily Maximum Daily Minimum	0.1
Total Residual Chlorine [3]	mg/L	Effluent	1/Week	Grab	Daily Maximum Monthly Average	0.1
Escherichia coli Bacteria [4]	cfu/100 mL	Effluent	1/Week	Grab	Weekly Average Monthly Average	1
Total Ammonia as N	mg/L	Effluent	1/Month	Composite	Daily Maximum Monthly Average	0.07
Nitrate + Nitrite as N	mg/L	Effluent	1/Month	Composite	Weekly Average Monthly Average	0.02
Total Kjeldahl Nitrogen	mg/L	Effluent	1/Month	Composite	Weekly Average Monthly Average	0.1
Total Nitrogen [5][8]	mg/L	Effluent	1/Month	Calculated	Weekly Average	0.1
	lb/day	N/A	1/Month	Calculated	Monthly Average	0.1
Total Phosphorus as P [8]	mg/L	Effluent	1/Month	Composite	Weekly Average	0.003
	lb/day	N/A	1/Month	Calculated	Monthly Average	0.01
Oil and Grease [6]	mg/L	Effluent	1/Quarter	Grab	Monthly Maximum	0.1
Copper, Total Recoverable	µg/L	Effluent	Semi-annual	Grab	Daily Maximum Monthly Average	2
Lead, Total Recoverable	µg/L	Effluent	Semi-annual	Grab	Daily Maximum Monthly Average	0.3
Zinc, Total Recoverable	µg/L	Effluent	Semi-annual	Grab	Daily Maximum Monthly Average	8

Footnotes:
(1) See Definition section at end of permit for explanation of terms.
(2) Percent (%) Removal shall be calculated using the monthly average values.
(3) The Permittee is only required to sample for total residual chlorine if chlorine is used as a disinfectant in the treatment process.
(4) Report Geometric Mean if more than one sample is collected during reporting period.
(5) Calculated as the sum of Nitrate + Nitrite as N and Total Kjeldahl Nitrogen (TKN) concentrations.
(6) Collect a sample and analyze using EPA Method 1664, Revision A: N-Hexane Extractable Material (HEM) or equivalent.
(7) ML is the minimum detection level.
(8) TN and TP monitoring is only required during July through October.

VII. Nonsignificance Determination

As discussed in the previous sections, the proposed effluent limits and discharge flows for the EHRC WWTP discharge do not allow for or constitute a new or increased source of pollutants pursuant to ARM 17.30.702(18). Therefore, a nonsignificance analysis is not required [ARM 17.30.705(1)].

VIII. Information Sources

1. Administrative Rules of Montana Title 17 Chapter 30 - Water Quality
   a. Sub-Chapter 2 - *Water Quality Permit and Application Fees.*
   b. Sub-Chapter 5 - *Mixing Zones in Surface and Ground Water*.
   c. Sub-Chapter 6 - *Montana Surface Water Quality Standards and Procedures*.
   d. Sub-Chapter 7- *Nondegradation of Water Quality*.
   e. Sub-Chapter 10 - *Montana Ground Water Pollution Control System.*
   f. Sub-Chapter 12 - *Montana Pollutant Discharge Elimination System (MPDES) Standards*.
   g. Sub-Chapter 13 - *Montana Pollutant Discharge Elimination System (MPDES) Permits*

2. Clean Water Act § 303(d), 33 USC 1313(d) *Montana List of Waterbodies in Need of Total Maximum Daily Load Development*, 1996 and 2006.

3. Federal Water Pollution Control Act (Clean Water Act), 33 U.S.C. §§ 1251-1387, October 18, 1972, as amended 1973-1983, 1987, 1988, 1990-1992, 1994, 1995 and 1996.

4. Montana Code Annotated Title 75 - Environmental Protection Chapter 5 - Water Quality, 2011.

5. Montana Department of Environmental Quality Circular DEQ-2, *Design Standards for Wastewater Facilities,* June 2016.

6. Montana Department of Environmental Quality Interdepartmental Memorandum from George Mathieus: *Implementation of the Wasteload Allocations Presented in the Framework Water Quality Restoration Plan and Total Maximum Daily Loads (TMDLs) for the Lake Helena Watershed Planning Area*, March 21, 2007.

7. Montana Department of Environmental Quality Circular DEQ-7, *Montana Numeric Water Quality Standards*, October 2012.

8. Montana Department of Fish Wildlife and Parks, *Spawning Times of Montana Fishes*, March 2001.

9. Montana Pollutant Discharge Elimination System (MPDES) Permit Number MT0023566
   a. Administrative Record.
   b. Renewal Application forms DEQ-1 and EPA 2C. July 2014.
   c. Compliance Inspection Reports, December 28, 2010 and December 23, 2014.

10. US Code of Federal Regulations, 40 CFR Parts 122-125, 130-133, & 136.

11. US Code of Federal Regulations, 40 CFR Part 403 – *General Pretreatment Regulations for Existing and New Sources of Pollution.*

12. US Code of Federal Regulations, 40 CFR Part 503 – *Standards for the Use or Disposal of Sewage Sludge.*

13. US Department of the Interior US Geological Survey, *Statistical Summaries of Streamflow in Montana and Adjacent Areas, Water Years1900 through 2009*, Scientific Investigations Report, 2015.

14. US EPA *Technical Support Document for Water Quality-Based Toxics Control*, EPA/505/2-30-001, March 1991.

15. USEPA Region VIII *Mixing Zones and Dilution Policy*, September 1995.

16. US EPA NPDES *Permit Writers' Manual*, EPA 833-K-10-001, September 2010.

17. US EPA Region VIII NPDES *Whole Effluent Toxics Control Program*, August 1997.

18. US EPA for Montana Department of Environmental Quality *Framework Water Quality Restoration Plan and Total Maximum Daily Loads (TMDLs) for the Lake Helena Watershed Planning Area:*
    a. Volume I – Appendices, December 2004.
    b. Volume II – Final Report, August 2006.

19. US EPA Ref. 8-MO, TMDL Approvals, *Lake Helena Total Maximum Daily Load Planning Area* and Enclosures, September 27, 2006.

20. Montana Fisheries Information System (MFISH)

Prepared by: Kaela Murphy, December 2016

Attachment A: Elkhorn Health and Rehabilitation Center WWTP Reasonable Potential Analysis (October 2016)

			TRC (Acute)	TRC (Chronic)	Ammonia (Acute)	Ammonia (Chronic)	N+N (HHS)	Nitrogen, total (TN) Seasonal	Phosphorus, total (TP) Seasonal
Flow									
critical stream flow	7Q10 or seasonal 14Q5	mgd	5.01	5.01	5.01	5.01	5.01	7.63	7.63
% of critical stream flow for dilution	as decimal	%	0.10	1.00	0.10	1.00	0.25	1.00	1.00
Q_s	resulting critical stream flow Q_s = (critical stream flow for dilution)*(% of critical stream flow provided)	**mgd**	**0.50**	**5.01**	**0.50**	**5.01**	**1.25**	**7.63**	**7.63**
Q_d	critical effluent flow (avg. daily design flow)	**mgd**	**0.015**	**0.015**	**0.015**	**0.015**	**0.015**	**0.015**	**0.015**
Q_r	downstream flow (Q_s + Q_d)	mgd	0.52	5.03	0.52	5.03	1.27	7.65	7.65
Concentrations									
C_{max}	maximum effluent concentration for POR (from application or DMR data)	mg/L	**0.5**	**0.5**	**7.66**	**7.66**	**14.6**	**11.7**	**2.70**
n	number of samples in effluent data set		24	24	22	22	24	8	8
CV	0.6 if n < 10 calculated as $\sigma_{effluent}/\mu_{effluent}$ if n ≥ 10		0.577	0.577	2.153	2.153	0.535	0.6	0.6
P_n	%tile for n samples at 95% confidence level		0.88	0.88	0.87	0.87	0.88	0.69	0.69
Z_{Pn}	Z-score for P_n		1.19	1.19	1.14	1.14	1.19	0.489	0.489
TSD	calculated TSD multiplier (should be close to Table 3-2		1.28	1.28	1.94	1.94	1.26	1.9	1.9
C_d	critical effluent concentration - 95%tile (=max. effluent concentration * TSD multiplier)	**mg/L**	**0.64**	**0.64**	**14.90**	**14.90**	**18.36**	**22.21**	**5.13**
C_s	critical instream concentration (75%tile if n<=30, 95% UCL if n>30)	**mg/L**	**0.00**	**0.00**	**0.05**	**0.05**	**0.025**	**0.10**	**0.015**
C_r	**resulting or downstream pollutant concentration** $C_r = (C_dQ_d + C_sQ_s)/(Q_d+Q_s)$	**mg/L**	**0.019**	**0.002**	**0.482**	**0.094**	**0.242**	**0.143**	**0.025**
WQS	**water quality standard**	**mg/L**	**0.019**	**0.011**	**3.83**	**1.79**	**10**	**0.300**	**0.030**
Reasonable Potential			**no**	**no**	**no**	**no**	**no**	**no**	**no**

Figure 1: Elkhorn Health and Rehabilitation Center Flow Diagram